PATENT ABSTRACTS OF JAPAN

(11)Publication number : 09-246148
(43)Date of publication of application : 19.09.1997

(51)Int.Cl. H01L 21/027
H01J 37/09
H01J 37/305

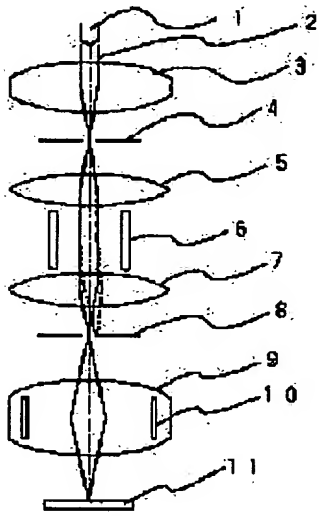
(21)Application number : 08-045821
(22)Date of filing : 04.03.1996

(71)Applicant : HITACHI LTD
(72)Inventor : OTA HIROYA
SOMETA YASUHIRO
OKUMURA MASAHIDE
NAKAYAMA YOSHINORI
SAITO NORIO

(54) METHOD AND APPARATUS FOR ELECTRON BEAM IMAGE DRAWING AND SEMICONDUCTOR INTEGRATED CIRCUIT DEVICE BY USE OF THIS

(57)Abstract:
PROBLEM TO BE SOLVED: To enlarge the area of a collective beam and to increase an image drawing speed by causing a beam to perform scanning, without lowering the current density of a variable forming beam.

SOLUTION: After an electron beam 2 emitted from an electron source 1 is converged by at least one focusing lens 3 and is shaped by a first apertures 4, it is converged by a first forming lens 5 and a second forming lens 7 and forms an image on the second aperture 8. This image on the second aperture 8 is projected and deflected by an objective lens 9 and an objective deflector 10, and radiates a sample 11 onto which a photosensitive agent has been applied and image drawing is performed. At this time, openings in the shapes of a plurality of patterns to be drawn provided in the second aperture 8 beforehand are selected by a deflector 6. By applying a scanning signal to the deflector 6 and performing scanning with a beam having a smaller area than an opening in the shape of a pattern on the second aperture 8, the area of a collective beam is extended practically without lowering a current density. By scanning a collective bean opening with a beam having a smaller area than the shape of the collective bean, it becomes possible to extend the outward area of the collective beam and to perform image drawing at a high speed.



LEGAL STATUS

[Date of request for examination]	03.10.2001
[Date of sending the examiner's decision of rejection]	
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	3465469
[Date of registration]	29.08.2003
[Number of appeal against examiner's decision of rejection]	

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] It is in the electron-beam-lithography approach performed using the diaphragm with opening of two or more specific configurations of determining the electron source which emits an electron beam, and the configuration of said electron beam, the 1st deflecting system which chooses opening of two or more of said specific configurations, and one or more electromagnetic lenses which project said electron beam. The electron-beam-lithography approach characterized by drawing by scanning with said electron beam which consists of the 1/2 or less sides of **** of the field with the specific function on the diaphragm with opening of said specific configuration of a mass of opening group.
[Claim 2] The electron-beam-lithography approach characterized by being in the electron-beam-lithography approach according to claim 1, and drawing by scanning with said electron beam of 1/4 or less area of the field with said specific function of a mass of opening group.
[Claim 3] The electron-beam-lithography approach characterized by drawing by scanning by being in the electron-beam-lithography approach given in either claim 1 or claim 2, and choosing the part of opening on the diaphragm with opening of two or more of said specific configurations.
[Claim 4] The electron-beam-lithography approach characterized by drawing by being in the electron-beam-lithography approach given in either claim 1, claim 2 or claim 3, and changing an electron beam dose by changing the rate or count which scans according to the location on the diaphragm with opening of two or more of said specific configurations.
[Claim 5] The electron beam exposure system characterized by being in the electron beam exposure system characterized by using the electron-beam-lithography approach of a publication for either claim 1, claim 2, claim 3 or claim 4, and providing the function on which the signal which scans to the 1st deflecting system which chooses opening of two or more of said specific configurations is made to superimpose.
[Claim 6] The electron beam exposure system characterized by being in the electron beam exposure system characterized by using the electron-beam-lithography approach of a publication for either claim 1, claim 2, claim 3 or claim 4, and forming the 2nd deflecting system which scans.
[Claim 7] Semiconductor integrated circuit equipment characterized by manufacturing using the electron-beam-lithography approach of a publication to either claim 1, claim 2, claim 3 or claim 4.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the electron beam lithography used for manufacture of a semiconductor device etc., and relates to the electron-beam-lithography approach and equipment which draw to a package with the electron beam of the configuration which appears especially repeatedly in a drawing pattern.
[0002]
[Description of the Prior Art] The electron beam lithography is used for the manufacture of a photo mask and the researches and developments of a tip device in semi-conductor manufacture from the function in which generating of the height and pattern of the definition is possible. In recent years, with detailed-izing of a semiconductor device, the processing dimension serves as same extent as the wavelength of the light source of optical exposure, and is approaching the resolution limit. For this reason, an electron beam lithography is being applied also to the production line which mass-produces in the layer which is hard to resolve by optical exposure even if it uses a super resolution technique etc. Although the package beam drawing method which irradiates a mass of opening group with a specific function at once was put in practical use and writing speed improved sharply, improvement in still bigger writing speed is demanded of the electron beam lithography.
[0003] Expansion of the area of a package beam is raised to the factor for raising the writing speed of a package beam method further. However, since the beam current emitted from a certain electron gun is fixed, if the area of a package beam is expanded, current density will decrease as a result. Moreover, it is practical to be able to draw no patterns of a semiconductor device only with a package beam, but to use together with a good conversion form method. If the area of a package beam is expanded and the current density of an electron beam decreases, contrary to this, the writing speed of the part which draws by the variable shaped beam will fall. For this reason, in order to usually obtain the maximum writing speed, the area of a package beam is optimized in consideration of factors, such as resist sensibility and the deviation setting latency time.
[0004] Moreover, since a package beam method is a method which draws by irradiating two or more patterns at once, the range irradiated at once cannot change an exposure. On the other hand, the method of giving distribution to an exposure is also proposed by piling up opening of the shape of an eye of a network different from package pattern opening as shown, for example in the publication-number No. 137520 [four to] official report.
[0005]
[Problem(s) to be Solved by the Invention] It is an effective means to expand the area of a package beam, in order to raise a throughput, and to decrease the number of shots by the electron beam lithography of a package beam method. However, since the amount of currents emitted from an electron gun is decided by physical properties, it is fixed. Therefore, when the area of a package beam is expanded, the current density of a beam will decrease. Since the sensibility of a sensitization agent is determined by the product of current density and irradiation time, if the sensibility of a sensitization agent is fixed, it is not concerned with the area of a beam but total irradiation time is fixed.
[0006] Usually, drawing of a package beam method cannot draw any patterns other than a repeat only with a package beam, either. Therefore, it is practical to use together with a variable shaped beam method. If the area of a package beam is expanded and current density decreases, the current density of a variable shaped beam will also decrease. Therefore, the writing speed of the part which draws by the variable shaped beam will decrease, and a synthetic throughput will fall. That is, a part of beam to irradiate will be used, and the beam irradiated in addition to opening has produced futility in order not to contribute to drawing.
[0007] This problem is solvable if beam size is changed by the case where opening of the case where opening of a package beam part is irradiated, and a variable shaped beam part is irradiated. However, the change of beam size must change the condition of convergence of a lens. Since the time amount which this takes requires great time amount compared with choosing opening, it does not become improvement in a synthetic throughput.
[0008]

[Means for Solving the Problem] The area of the package beam on appearance is expanded by arranging the deflecting system only for scans and scanning with 1/4 or less small beam with 1/2 or less and area of **** from the package shape of beam which is a mass of opening group with a specific function, using the deflecting system for the opening selection after the diaphragm which determines the configuration of a package beam. By forming a variable shaped beam with a beam with this small area, drawing also of patterns other than a package beam pattern is possible in high current density. Moreover, an exposure is controlled by changing the rate and count of a scan.

[0009]

[Embodiment of the Invention] It is an effective means to expand the area of a package beam, in order to raise a throughput, and to decrease the number of shots by the electron beam lithography of a package beam method. When the area of a package beam is expanded, the current density of a beam will decrease. If the sensibility of a sensitization agent is fixed, it is not concerned with the area of a beam but total irradiation time is fixed. Usually, drawing of a package beam method can also draw no patterns only with a package beam. Therefore, it is practical to use together with a variable shaped beam method. If the area of a package beam is expanded and current density decreases, the current density of a variable shaped beam will also decrease. Consequently, the writing speed of the part which draws by the variable shaped beam will decrease, and a synthetic throughput will fall.

[0010] The area of the package beam on appearance is expanded by arranging the deflecting system only for scans and scanning with a beam with an area smaller than the package shape of beam which is a mass of opening group with a specific function, using the deflecting system for the opening selection after the diaphragm which determines the configuration of a package beam.

[0011] Since the minimum counts which scan the field of a package beam are two round trips when scanning with a beam with an area smaller than the package shape of beam, it is effective to use the beam of 1/2 or less dimension of a field. When 1/2 or more beams are used, the part which remains in a scan field required of two scans arises, and this does not contribute to drawing. Since exposure unevenness will occur if multiplex drawing is carried out by the 1st time and the 2nd time, it scans so that it may not lap and is because there is nothing if it is inside ****. Therefore, 1/4 or less beam is used in 1/2 or less [of **** of the field to scan], and area. By forming a variable shaped beam with a beam with this small area, drawing is possible in high current density. Moreover, an exposure is controlled by changing the rate and count of a scan.

[0012] (Example 1) Drawing 1 is drawing having shown the 1st example of this invention.

[0013] After converging with one or more focusing lenses 3 and fabricating the electron beam 2 (image formation relation is shown) emitted from the electron source 1 by the 1st aperture 4, it converges with the 1st shaping lens 5 and the 2nd shaping lens 7, and image formation of it is carried out on the 2nd aperture 8. The image on this 2nd aperture 8 draws by carrying out a projection deviation with an objective lens 9 and the object deflecting system 10, and irradiating on the sample 11 to which the sensitization agent was applied. Opening of the pattern configuration which the plurality beforehand prepared in the 2nd aperture 8 at this time should draw is chosen with deflecting system 6.

[0014] Since the radiation angle current density of an electron source 1 is decided depending on the physical properties of an ingredient, the current value which can be used for drawing with an electron beam with a certain uniform current density and specific area becomes fixed. In order to expand the area of a package beam, a focusing lens 3 is adjusted, and angular aperture must be extended and must be irradiated. For this reason, current density will be set to one half if the area of a package beam is doubled, for example. Usually, the pattern of an actual semiconductor integrated circuit is complicated, and since it cannot draw only with a package beam, it is drawing by also preparing opening for good conversion mold methods in the 2nd aperture 8, and changing according to a pattern. Usually, since the pattern which draws by the good conversion form method has that it is [much] smaller than the area of a package beam, when a beam with the low current density for package beams is used, the beam which does not reach a sample and does not contribute to drawing will increase.

[0015] In order to solve this problem, it is possible, if the convergence force of a focusing lens 3 is changed by the object for package beams, and the object for good conversion molds and it is set as the respectively optimal beam area. However, since a focusing lens 3 uses an electromagnetic lens with a large inductance, the change of the convergence force usually takes long time amount compared with selection of opening on the 2nd aperture 8 by deflecting system 6. the change of this convergence force -- ** -- it does not become improvement in writing speed as a result.

[0016] Therefore, current density required for a good conversion form method is set up with a focusing lens 3, and if the part of a package beam with a larger area than this scans a beam, the large package beam of area can be realized. Moreover, if this beam area is fixed, a focusing lens 3 may become unnecessary. The sensibility of the sensitization agent applied on the sample 11 is equal to the electron beam dose per unit area, and is determined by the product of the current density of an electron beam, and residence time. When the sensibility of a sensitization agent is fixed, the residence time of the sum total when residence time and current density when [that current density is low] area is large scan a high beam continuously becomes equal. Therefore, the time amount required also when opening on the

2nd aperture 8 is scanned with a beam with an area smaller than a package beam, and also when the area of a package beam is expanded is the same.

[0017] The case where it scans with a beam with an area smaller than a package beam is shown in drawing 2 . The opening 12 for package beams with the specific function on the 2nd aperture 8 which is a mass of opening group is scanned with the electron beam 2 smaller than the area of opening. At this time, the opening 13 for good conversion mold beams should just be more than the area of an electron beam 2. On the other hand, the conventional package beam method is shown in drawing 3 . The opening 12 for package beams on the 2nd aperture 8 was irradiated with the larger electron beam 2 than the area of opening at the package.

[0018] (Example 2) The path of a scan with an electron beam 2 is shown in drawing 4 . It is shown that drawing 4 (a) scans the opening 12 for package beams on the 2nd aperture 8 in the scan path 14 with an electron beam 2. Thus, as long as it scans the whole surface product of the opening 12 for package beams with an electron beam 2, what kind of pattern is sufficient as the opening 12 for package beams.

[0019] However, there is a layer with a small area of each pattern which draws like the Hall system in actual semiconductor manufacture. The example shown in drawing 4 (b) has a small area of the opening 15 occupied in the opening 12 for package beams, and the electron beam 2 which irradiated parts other than opening does not contribute to drawing. When the opening 15 of each pattern is small and each opening 15 is separated, only an opening part is alternatively scanned like the scan path 16. In this case, it becomes possible to use the current of an electron beam 2 effectively, and writing speed improves further. Whenever this approach changes a drawing pattern, it needs to change a scan location. Therefore, what is necessary is to record positional information, in case the 2nd aperture 8 is produced, and just to read pattern arrangement information, whenever a pattern changes.

[0020] If it scans by choosing only the part of opening 15, only the ratio of the area of an electron beam 2 and the opening 12 for package beams can raise writing speed.

[0021] (Example 3) The so-called package beam method as shown in drawing 3 is the approach usual in controlling an exposure by time amount from ON of an electron beam 2 to OFF. On the other hand, the approach of controlling an exposure by this drawing approach shown in drawing 2 has the following two possible kinds. The 1st is a method with which an electron beam 2 scans the opening 12 top for package beams only once. This changes the rate of a scan according to the residence time of the electron beam 2 determined from a required dose and the current density of an electron beam 2. The 2nd is a method which performs a multiple-times scan for the opening 12 top for package beams. The rate of one scan is immobilization and this scans by the count of a required exposure.

[0022] The case where an exposure is changed by one scan is explained in full detail. What is necessary is just to change the rate of a scan in inverse proportion to a required exposure, in scanning the whole surface product of the opening 12 for package beams as shown in drawing 4 (a) with an electron beam 2. Moreover, when the scan path 16 as shown in drawing 4 (b) scans only a part for opening alternatively, as for the time amount to which the electron beam 2 is staying at opening 15, a scan is suspended, and the migration to opening from opening should just scan with the full speed of the deflecting system for a scan. Furthermore, when the area of an electron beam 2 is larger than opening 15, only the part of the difference of the scan lay length of an electron beam 2 and opening 15 is possible for making loose halt stability of the deflecting system for a scan.

[0023] When carrying out a multiple-times scan, only many [in any / of (a) of drawing 4 and (b) / case] part to an exposure should make [many] the count of a scan.

[0024] As a result of using this approach, proximity effect correction for which the exposure inside a package graphic form becomes possible [setting it as arbitration], especially it depends on an exposure can be performed with high precision.

[0025] (Example 4) Drawing 5 is drawing which expanded the parts of the 1st shaping lens 5 and the 2nd shaping lens 7, and shows the example which superimposed the signal for a scan on deflecting system. The same deflecting system 6 performs selection and a scan by adding the scan signal from scan signal generation equipment 18 to the signal of the selection-control equipment 17 which sends a signal to deflecting system 6.

[0026] (Example 5) Drawing 6 is drawing which expanded the parts of the 1st shaping lens 5 and the 2nd shaping lens 7, and shows the example which newly added the deflecting system for a scan. The signal of selection-control equipment 17 is supplied to the conventional deflecting system 6, the scan signal from scan signal generation equipment 18 is supplied to the deflecting system 19 for a scan, and selection and a scan are performed independently.

[0027] (Example 6) The production process of a semiconductor integrated circuit which used the electron-beam-lithography approach of this invention for drawing 7 is shown.

[0028] Drawing 7 A to drawing 7 D is the sectional view of a component showing the process. 22, field oxide 23, the polycrystalline silicon / silicon oxide gate 24, P high concentration diffusion layer 25, N high concentration diffusion layer 26, etc. were formed in N minus silicon substrate 20 21 or P layers of layers P well by the usual approach (drawing 7 A). Next, the insulator layer 27 of phosphorus glass (PSG) was put, dry etching of the insulator layer 27 was carried out, and the contact hole 28 was formed (drawing 7 B).

[0029] Next, W/TiN electrode wiring 30 material was put by the usual approach, the sensitization agent 29 was applied on it, and pattern NINGU of the sensitization agent 29 was performed using the electron-beam-lithography approach of this invention (drawing 7 C). And the W/TiN electrode wiring 30 was formed by dry etching etc.
[0030] Next, the interlayer insulation film 31 was formed and the hole pattern 32 was formed by the usual approach. The inside of the hole pattern 32 embedded with W plug, and connected the 2nd wiring 33 of aluminum (drawing 7 D). Subsequent passivation processes used the conventional method.
[0031] In addition, although this example explained only the main production processes, the same process as a conventional method was used except having used the electron-beam-lithography approach of this invention at the lithography process of W/TiN electrode wiring formation. According to the above process, the pattern could be formed without quality deteriorating and CMOSLSI was able to be manufactured by the high yield. As a result of manufacturing a semiconductor integrated circuit using the electron-beam-lithography approach of this invention, the volume per unit time amount by writing speed having improved increased.
[0032]
[Effect of the Invention] By scanning package beam opening with a beam with an area smaller than the package shape of beam which is a mass of opening group with a specific function, the area of the package beam on appearance can be expanded and it can draw at a high speed.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

TECHNICAL FIELD

[Field of the Invention] This invention relates to the electron beam lithography used for manufacture of a semiconductor device etc., and relates to the electron-beam-lithography approach and equipment which draw to a package with the electron beam of the configuration which appears especially repeatedly in a drawing pattern.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

PRIOR ART

[Description of the Prior Art] The electron beam lithography is used for the manufacture of a photo mask and the researches and developments of a tip device in semi-conductor manufacture from the function in which generating of the height and pattern of the definition is possible. In recent years, with detailed-izing of a semiconductor device, the processing dimension serves as same extent as the wavelength of the light source of optical exposure, and is approaching the resolution limit. For this reason, an electron beam lithography is being applied also to the production line which mass-produces in the layer which is hard to resolve by optical exposure even if it uses a super resolution technique etc. Although the package beam drawing method which irradiates a mass of opening group with a specific function at once was put in practical use and writing speed improved sharply, improvement in still bigger writing speed is demanded of the electron beam lithography.

[0003] Expansion of the area of a package beam is raised to the factor for raising the writing speed of a package beam method further. However, since the beam current emitted from a certain electron gun is fixed, if the area of a package beam is expanded, current density will decrease as a result. Moreover, it is practical to be able to draw no patterns of a semiconductor device only with a package beam, but to use together with a good conversion form method. If the area of a package beam is expanded and the current density of an electron beam decreases, contrary to this, the writing speed of the part which draws by the variable shaped beam will fall. For this reason, in order to usually obtain the maximum writing speed, the area of a package beam is optimized in consideration of factors, such as resist sensibility and the deviation setting latency time.

[0004] Moreover, since a package beam method is a method which draws by irradiating two or more patterns at once, the range irradiated at once cannot change an exposure. On the other hand, the method of giving distribution to an exposure is also proposed by piling up opening of the shape of an eye of a network different from package pattern opening as shown, for example in the publication-number No. 137520 [four to] official report.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

EFFECT OF THE INVENTION

[Effect of the Invention] By scanning package beam opening with a beam with an area smaller than the package shape of beam which is a mass of opening group with a specific function, the area of the package beam on appearance can be expanded and it can draw at a high speed.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] It is an effective means to expand the area of a package beam, in order to raise a throughput, and to decrease the number of shots by the electron beam lithography of a package beam method. However, since the amount of currents emitted from an electron gun is decided by physical properties, it is fixed. Therefore, when the area of a package beam is expanded, the current density of a beam will decrease. Since the sensibility of a sensitization agent is determined by the product of current density and irradiation time, if the sensibility of a sensitization agent is fixed, it is not concerned with the area of a beam but total irradiation time is fixed.

[0006] Usually, drawing of a package beam method cannot draw any patterns other than a repeat only with a package beam, either. Therefore, it is practical to use together with a variable shaped beam method. If the area of a package beam is expanded and current density decreases, the current density of a variable shaped beam will also decrease. Therefore, the writing speed of the part which draws by the variable shaped beam will decrease, and a synthetic throughput will fall. That is, a part of beam to irradiate will be used, and the beam irradiated in addition to opening has produced futility in order not to contribute to drawing.

[0007] This problem is solvable if beam size is changed by the case where opening of the case where opening of a package beam part is irradiated, and a variable shaped beam part is irradiated. However, the change of beam size must change the condition of convergence of a lens. Since the time amount which this takes requires great time amount compared with choosing opening, it does not become improvement in a synthetic throughput.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

MEANS

[Means for Solving the Problem] The area of the package beam on appearance is expanded by arranging the deflecting system only for scans and scanning with 1/4 or less small beam with 1/2 or less and area of **** from the package shape of beam which is a mass of opening group with a specific function, using the deflecting system for the opening selection after the diaphragm which determines the configuration of a package beam. By forming a variable shaped beam with a beam with this small area, drawing also of patterns other than a package beam pattern is possible in high current density. Moreover, an exposure is controlled by changing the rate and count of a scan.
[0009]
[Embodiment of the Invention] It is an effective means to expand the area of a package beam, in order to raise a throughput, and to decrease the number of shots by the electron beam lithography of a package beam method. When the area of a package beam is expanded, the current density of a beam will decrease. If the sensibility of a sensitization agent is fixed, it is not concerned with the area of a beam but total irradiation time is fixed. Usually, drawing of a package beam method can also draw no patterns only with a package beam. Therefore, it is practical to use together with a variable shaped beam method. If the area of a package beam is expanded and current density decreases, the current density of a variable shaped beam will also decrease. Consequently, the writing speed of the part which draws by the variable shaped beam will decrease, and a synthetic throughput will fall.
[0010] The area of the package beam on appearance is expanded by arranging the deflecting system only for scans and scanning with a beam with an area smaller than the package shape of beam which is a mass of opening group with a specific function, using the deflecting system for the opening selection after the diaphragm which determines the configuration of a package beam.
[0011] Since the minimum counts which scan the field of a package beam are two round trips when scanning with a beam with an area smaller than the package shape of beam, it is effective to use the beam of 1/2 or less dimension of a field. When 1/2 or more beams are used, the part which remains in a scan field required of two scans arises, and this does not contribute to drawing. Since exposure unevenness will occur if multiplex drawing is carried out by the 1st time and the 2nd time, it scans so that it may not lap and is because there is nothing if it is inside ****. Therefore, 1/4 or less beam is used in 1/2 or less [of **** of the field to scan], and area. By forming a variable shaped beam with a beam with this small area, drawing is possible in high current density. Moreover, an exposure is controlled by changing the rate and count of a scan.
[0012] (Example 1) Drawing 1 is drawing having shown the 1st example of this invention.
[0013] After converging with one or more focusing lenses 3 and fabricating the electron beam 2 (image formation relation is shown) emitted from the electron source 1 by the 1st aperture 4, it converges with the 1st shaping lens 5 and the 2nd shaping lens 7, and image formation of it is carried out on the 2nd aperture 8. The image on this 2nd aperture 8 draws by carrying out a projection deviation with an objective lens 9 and the object deflecting system 10, and irradiating on the sample 11 to which the sensitization agent was applied. Opening of the pattern configuration which the plurality beforehand prepared in the 2nd aperture 8 at this time should draw is chosen with deflecting system 6.
[0014] Since the radiation angle current density of an electron source 1 is decided depending on the physical properties of an ingredient, the current value which can be used for drawing with an electron beam with a certain uniform current density and specific area becomes fixed. In order to expand the area of a package beam, a focusing lens 3 is adjusted, and angular aperture must be extended and must be irradiated. For this reason, current density will be set to one half if the area of a package beam is doubled, for example. Usually, the pattern of an actual semiconductor integrated circuit is complicated, and since it cannot draw only with a package beam, it is drawing by also preparing opening for good conversion mold methods in the 2nd aperture 8, and changing according to a pattern. Usually, since the pattern which draws by the good conversion form method has that it is [much] smaller than the area of a package beam, when a beam with the low current density for package beams is used, the beam which does not reach a sample and does not contribute to drawing will increase.
[0015] In order to solve this problem, it is possible, if the convergence force of a focusing lens 3 is changed by the

object for package beams, and the object for good conversion molds and it is set as the respectively optimal beam area. However, since a focusing lens 3 uses an electromagnetic lens with a large inductance, the change of the convergence force usually takes long time amount compared with selection of opening on the 2nd aperture 8 by deflecting system 6. the change of this convergence force -- ** -- it does not become improvement in writing speed as a result.

[0016] Therefore, current density required for a good conversion form method is set up with a focusing lens 3, and if the part of a package beam with a larger area than this scans a beam, the large package beam of area can be realized. Moreover, if this beam area is fixed, a focusing lens 3 may become unnecessary. The sensibility of the sensitization agent applied on the sample 11 is equal to the electron beam dose per unit area, and is determined by the product of the current density of an electron beam, and residence time. When the sensibility of a sensitization agent is fixed, the residence time of the sum total when residence time and current density when [that current density is low] area is large scan a high beam continuously becomes equal. Therefore, the time amount required also when opening on the 2nd aperture 8 is scanned with a beam with an area smaller than a package beam, and also when the area of a package beam is expanded is the same.

[0017] The case where it scans with a beam with an area smaller than a package beam is shown in drawing 2 . The opening 12 for package beams with the specific function on the 2nd aperture 8 which is a mass of opening group is scanned with the electron beam 2 smaller than the area of opening. At this time, the opening 13 for good conversion mold beams should just be more than the area of an electron beam 2. On the other hand, the conventional package beam method is shown in drawing 3 . The opening 12 for package beams on the 2nd aperture 8 was irradiated with the larger electron beam 2 than the area of opening at the package.

[0018] (Example 2) The path of a scan with an electron beam 2 is shown in drawing 4 . It is shown that drawing 4 (a) scans the opening 12 for package beams on the 2nd aperture 8 in the scan path 14 with an electron beam 2. Thus, as long as it scans the whole surface product of the opening 12 for package beams with an electron beam 2, what kind of pattern is sufficient as the opening 12 for package beams.

[0019] However, there is a layer with a small area of each pattern which draws like the Hall system in actual semiconductor manufacture. The example shown in drawing 4 (b) has a small area of the opening 15 occupied in the opening 12 for package beams, and the electron beam 2 which irradiated parts other than opening does not contribute to drawing. When the opening 15 of each pattern is small and each opening 15 is separated, only an opening part is alternatively scanned like the scan path 16. In this case, it becomes possible to use the current of an electron beam 2 effectively, and writing speed improves further. Whenever this approach changes a drawing pattern, it needs to change a scan location. Therefore, what is necessary is to record positional information, in case the 2nd aperture 8 is produced, and just to read pattern arrangement information, whenever a pattern changes.

[0020] If it scans by choosing only the part of opening 15, only the ratio of the area of an electron beam 2 and the opening 12 for package beams can raise writing speed.

[0021] (Example 3) The so-called package beam method as shown in drawing 3 is the approach usual in controlling an exposure by time amount from ON of an electron beam 2 to OFF. On the other hand, the approach of controlling an exposure by this drawing approach shown in drawing 2 has the following two possible kinds. The 1st is a method with which an electron beam 2 scans the opening 12 top for package beams only once. This changes the rate of a scan according to the residence time of the electron beam 2 determined from a required dose and the current density of an electron beam 2. The 2nd is a method which performs a multiple-times scan for the opening 12 top for package beams. The rate of one scan is immobilization and this scans by the count of a required exposure.

[0022] The case where an exposure is changed by one scan is explained in full detail. What is necessary is just to change the rate of a scan in inverse proportion to a required exposure, in scanning the whole surface product of the opening 12 for package beams as shown in drawing 4 (a) with an electron beam 2. Moreover, when the scan path 16 as shown in drawing 4 (b) scans only a part for opening alternatively, as for the time amount to which the electron beam 2 is staying at opening 15, a scan is suspended, and the migration to opening from opening should just scan with the full speed of the deflecting system for a scan. Furthermore, when the area of an electron beam 2 is larger than opening 15, only the part of the difference of the scan lay length of an electron beam 2 and opening 15 is possible for making loose halt stability of the deflecting system for a scan.

[0023] When carrying out a multiple-times scan, only many [in any / of (a) of drawing 4 and (b) / case] part to an exposure should make [many] the count of a scan.

[0024] As a result of using this approach, proximity effect correction for which the exposure inside a package graphic form becomes possible [setting it as arbitration], especially it depends on an exposure can be performed with high precision.

[0025] (Example 4) Drawing 5 is drawing which expanded the parts of the 1st shaping lens 5 and the 2nd shaping lens 7, and shows the example which superimposed the signal for a scan on deflecting system. The same deflecting system 6 performs selection and a scan by adding the scan signal from scan signal generation equipment 18 to the signal of the selection-control equipment 17 which sends a signal to deflecting system 6.

[0026] (Example 5) Drawing 6 is drawing which expanded the parts of the 1st shaping lens 5 and the 2nd shaping lens 7, and shows the example which newly added the deflecting system for a scan. The signal of selection-control equipment 17 is supplied to the conventional deflecting system 6, the scan signal from scan signal generation equipment 18 is supplied to the deflecting system 19 for a scan, and selection and a scan are performed independently

[0027] (Example 6) The production process of a semiconductor integrated circuit which used the electron-beam-lithography approach of this invention for drawing 7 is shown.
[0028] Drawing 7 A to drawing 7 D is the sectional view of a component showing the process. 22, field oxide 23, the polycrystalline silicon / silicon oxide gate 24, P high concentration diffusion layer 25, N high concentration diffusion layer 26, etc. were formed in N minus silicon substrate 20 21 or P layers of layers P well by the usual approach (drawing 7 A). Next, the insulator layer 27 of phosphorus glass (PSG) was put, dry etching of the insulator layer 27 was carried out, and the contact hole 28 was formed (drawing 7 B).
[0029] Next, W/TiN electrode wiring 30 material was put by the usual approach, the sensitization agent 29 was applied on it, and pattern NINGU of the sensitization agent 29 was performed using the electron-beam-lithography approach of this invention (drawing 7 C). And the W/TiN electrode wiring 30 was formed by dry etching etc.
[0030] Next, the interlayer insulation film 31 was formed and the hole pattern 32 was formed by the usual approach. The inside of the hole pattern 32 embedded with W plug, and connected the 2nd wiring 33 of aluminum (drawing 7 D). Subsequent passivation processes used the conventional method.
[0031] In addition, although this example explained only the main production processes, the same process as a conventional method was used except having used the electron-beam-lithography approach of this invention at the lithography process of W/TiN electrode wiring formation. According to the above process, the pattern could be formed without quality deteriorating and CMOSLSI was able to be manufactured by the high yield. As a result of manufacturing a semiconductor integrated circuit using the electron-beam-lithography approach of this invention, the volume per unit time amount by writing speed having improved increased.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] Drawing showing the 1st example of this invention.
[Drawing 2] Drawing showing the case where it scans with a beam with a small area.
[Drawing 3] Drawing showing the conventional package beam method.
[Drawing 4] Drawing showing the path of a scan.
[Drawing 5] Drawing having shown the example which superimposed the signal for a scan on deflecting system.
[Drawing 6] Drawing showing the example which newly added the deflecting system for a scan
[Drawing 7] Drawing showing the production process of the semiconductor integrated circuit using the electron-beam-lithography approach of this invention.
[Description of Notations]
An electron source, 2:electron beam, 3:convergent lens, 4 : 1: The 1st aperture, 5: -- the 1st shaping lens, 6:deflecting system, and 7: -- the 2nd shaping lens and 8: -- the 2nd aperture 9 : An objective lens, 10:object deflecting system, 11:sample, opening for 12:package beams, 13: Opening for variable shaped beams, 14:scan path, 15:opening, 16 : A scan path, 17: Selection-control equipment, 18 : Scan signal generation equipment, the deflecting system for 19 scans, a 20:N minus silicon substrate and 21 :P a well -- a layer and 22 :P a layer and 23:field oxide -- 24: Polycrystalline silicon / silicon oxide gate, 25 :P A high-concentration diffusion layer, a 26:N high-concentration diffusion layer, 27:insulator layer, 28:contact hole, 29:sensitization agent, 30:W/Ti electrode wiring, 31:interlayer insulation film, 32 :hole patterns, 33: The 2nd wiring of aluminum

[Translation done.]

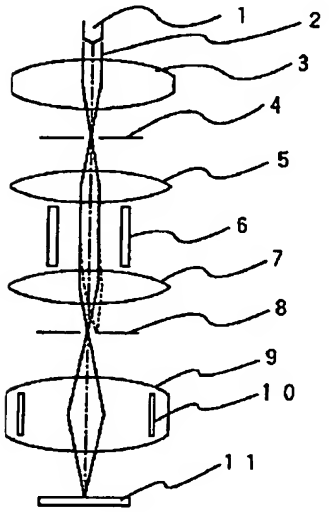
* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

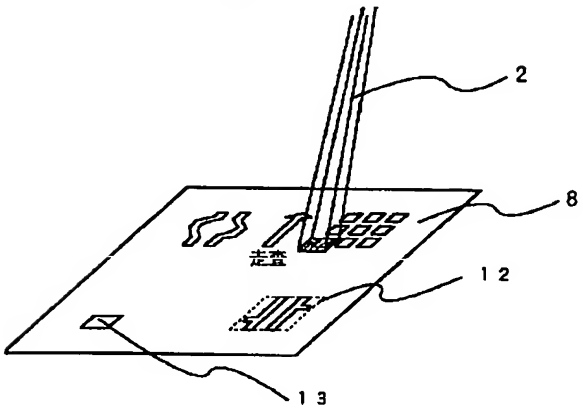
[Drawing 1]

図 1



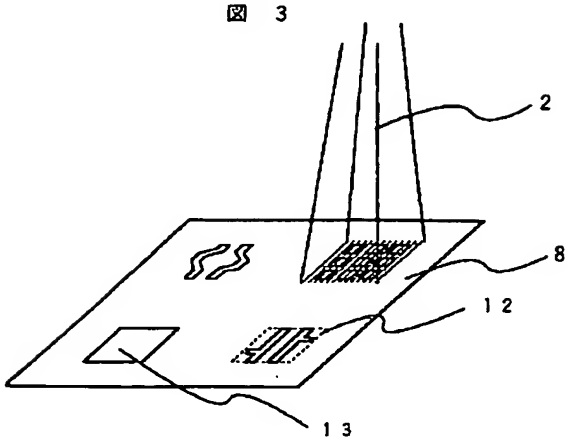
[Drawing 2]

図 2



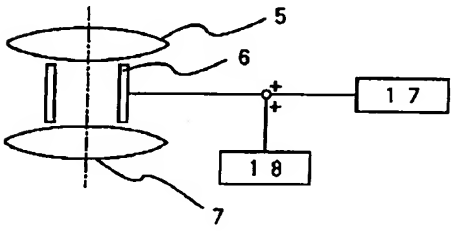
[Drawing 3]

図 3



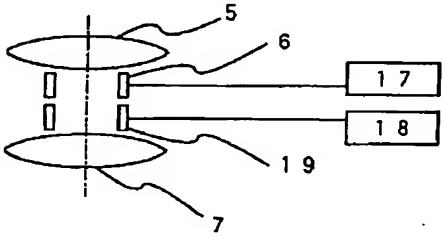
[Drawing 5]

図 5



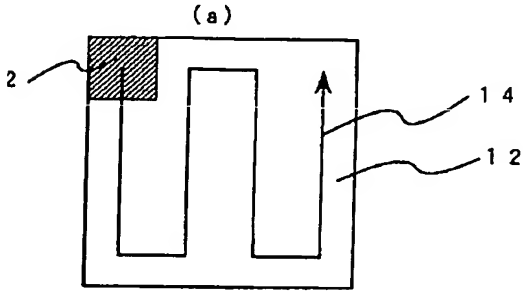
[Drawing 6]

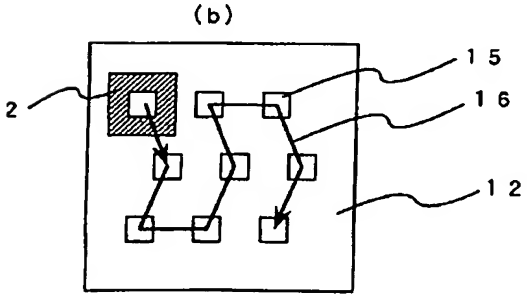
図 6



[Drawing 4]

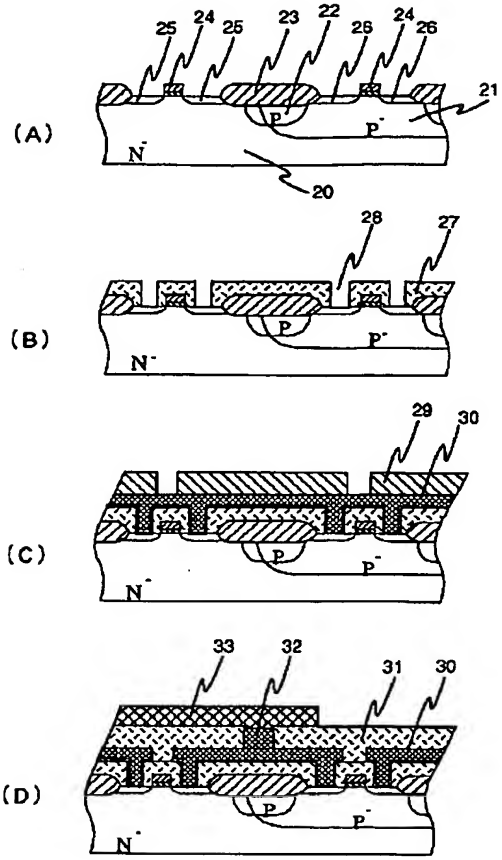
図 4





[Drawing 7]

図 7



[Translation done.]